WHAT IS CLAIMED IS:

1. A computerized method for assigning observations comprising:

receiving a plurality of first observations indicative of respective physical parameters observed by a first sensor system and receiving a plurality of second observations indicative of respective physical parameters observed by a second sensor system;

assigning, by a computer, a set of pairs of the first and second observations predicted to correspond to the same physical parameter, the assigning comprising:

receiving a cost function that specifies a cost for each assigned pair, the cost not independent of the assignment of any other assigned pairs in the set of assigned pairs; and

determining the set of assigned pairs corresponding to an optimal value for the cost function by calculating, by the computer, a corresponding optimal value for a directed graph representative of possible assignments of first and second observations.

2. The method of Claim 1, wherein the directed graph comprises a plurality of nodes each representing an assignment hypothesis, the plurality of nodes comprising a root node, wherein each node except for the root node has an associated input arc representing an assignment decision and wherein the length of each input arc is representative of a change in an assignment score resulting from the assignment decision, wherein the plurality of nodes are grouped in a plurality of stages.

3.   The method of Claim 1, wherein calculating, by
the computer, a corresponding optimal value for a
directed graph representative of possible assignments of
5   first and second observations comprises calculating the
optimal value by a network shortest path algorithm.

4.   The method of Claim 1', wherein calculating, by
the computer, a corresponding optimal value for a
10   directed graph representative of possible assignments of
first and second observations comprises calculating the
optimal value by a Dijkstra algorithm.

5.   The method of Claim 1, wherein the cost
15   function is

$$J_{s=} - \overline{x} R^{-1} \overline{x}^T - \sum_{i=1}^{s} \left\{ \begin{matrix} \delta x_i S_i^{-1} \delta x_i^T + \ln\left[\|S_i\|\right] - \ln(d_{min}) & a(i) \neq 0 \\ \overline{g} & a(i) = 0 \end{matrix} \right\} + \left\{ \begin{matrix} \ln\left(\left[2\pi\right]^M |R|\right) & n_a = 0 \\ 0 & n_a > 0 \end{matrix} \right\}$$

wherein J_s =   Assignment score
           $\overline{x}$ =   Estimate of relative bias
           R =   Relative registration covariance
20   matrix
           δx_i =   State vector difference = $A_i - B_{a(i)} - \overline{x}$
           S_i =   Residual error covariance for pair A_i
                and $B_{a(i)}$
           d_{min} =   Minimum determinant of a residual
25   error matrix
           g =   Gate value
           M =   Number of first observations
           n_a =   Number of non-zero entries in a
           a =   Assignment vector: $a_{(i)} > 0 \rightarrow A_i$ is
30   assigned to $B_{a(i)}$
           A_i =   The plurality of first observations
           $B_{a(i)}$ =   The plurality of second observations
                assigned to A_i

6.   The method of Claim 5, wherein the relative bias, $\bar{x}$, of the cost function is a simple bias.

5   7.   The method of Claim 5, wherein the relative bias, $\bar{x}$, of the cost function is a functional bias.

8.   The method of Claim 1, wherein assigning, by a computer, comprises assigning by a processor operable to

10   execute a computer program stored on a computer readable medium.

9.   The method of Claim 1, wherein assigning, by a computer, comprises assigning by an application specific

15   integrated circuit.

10.   The method of Claim 1, wherein assigning, by a computer, comprises assigning by a digital signal processor.

11. A computerized method for determining the N-
best observation assignments comprising:

      receiving   a   plurality   of   first   observations
indicative of respective physical parameters observed by
5 a first sensor system and receiving a plurality of second
observations indicative of respective physical parameters
observed by a second sensor system;

      determining, by a computer, one or more sets of
pairs of the first and second observations predicted to
10 correspond   to   the   same   physical   parameter,   the
determining comprising:

         receiving a cost function that specifies a cost
      for each assigned pair;

         determining   a   set   of   assigned   pairs
15   corresponding to an optimal value for the cost
      function by calculating, by the computer, a
      corresponding optimal value for a directed graph
      representative   of   possible   assignments   of
      corresponding first and second observations; and

20   repeating the determining act until a desired
      number   of   best   observation   assignments   is
      determined.

      12. The method of Claim 11, wherein the cost
25 specified by the cost function for each assigned pair is
not independent of the assignment of any other assigned
pairs in the respective set of assigned pairs.

13. The method of Claim 11, wherein the directed graph comprises a plurality of nodes each representing an assignment hypothesis, the plurality of nodes comprising a root node, wherein each node except for the root node

5   has an associated input arc representing an assignment decision and wherein the length of each input arc is representative of a change in an assignment score resulting from the assignment decision, wherein the plurality of nodes are grouped in a plurality of stages.

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14. The method of Claim 11, wherein calculating, by the computer, a corresponding optimal value for a directed graph representative of possible assignments of first and second observations comprises calculating the

15 optimal value by a network shortest path algorithm.

15. The method of Claim 11, wherein calculating, by the computer, a corresponding optimal value for a directed graph representative of possible assignments of

20 first and second observations comprises calculating the optimal value by a Dijkstra algorithm.

16. The method of Claim 11, wherein the cost function is

$$J_{s=} - \overline{x}R^{-1}\overline{x}^{T} - \sum_{i=1}^{s}\left\{ \begin{matrix} \delta x_i S_i^{-1}\delta x_i^{T} + \ln\!\left[\|S_i\|\right] - \ln(d_{\min}) & a(i)\neq 0 \\ \overline{g} & a(i)=0 \end{matrix} \right\} + \left\{ \begin{matrix} \ln\!\left(\left[2\pi\right]^{M}|R|\right) & n_a = 0 \\ 0 & n_a > 0 \end{matrix} \right\}$$

wherein J_s = Assignment score

$\overline{x}$ = Estimate of relative bias

R = Relative registration covariance matrix

δx_i = State vector difference = $A_i - B_{a(i)} - \overline{x}$

S_i = Residual error covariance for pair A_i and $B_{a(i)}$

d_{min} = Minimum determinant of a residual error matrix

g = Gate value

M = Number of first observations

n_a = Number of non-zero entries in a

a = Assignment vector: $a_{(i)} > 0 \to A_i$ is assigned to $B_{a(i)}$

A_i = The plurality of first observations

$B_{a(i)}$ = The plurality of second observations assigned to A_i

17. The method of Claim 16, wherein the relative bias, $\overline{x}$, of the cost function is a simple bias.

18. The method of Claim 16, wherein the relative bias, $\overline{x}$, of the cost function is a functional bias.

19. The method of Claim 11, wherein assigning, by a computer, comprises assigning by a processor operable to execute a computer program stored on a computer readable medium.

20.   The method of Claim 11, wherein assigning, by a computer, comprises assigning by an application specific integrated circuit.

5   21.   The method of Claim 11, wherein assigning, by a computer, comprises assigning by a digital signal processor.

22. A system for assigning observations comprising:

a computer readable medium; and

a computer program stored on the computer readable medium, the computer program operable, when executed on a

5   processor, to:

receive a plurality of first observations indicative of respective physical parameters observed by a first sensor system and receiving a plurality of second observations indicative of

10   respective physical parameters observed by a second sensor system;

assign a set of pairs of the first and second observations predicted to correspond to the same physical parameter, the assignment comprising:

15   receiving a cost function that specifies a cost for each assigned pair, the cost not independent of the assignment of any other assigned pairs in the set of assigned pairs; and

20   determining the set of assigned pairs corresponding to an optimal value for the cost function by calculating, by the computer, a corresponding optimal value for a directed graph representative of possible assignments of

25   first and second observations.

23. The system of Claim 22, and further comprising a processor operable to execute the computer program.

24. The system of Claim 22, wherein the directed graph comprises a plurality of nodes each representing an assignment hypothesis, the plurality of nodes comprising a root node, wherein each node except for the root node

5 has an associated input arc representing an assignment decision and wherein the length of each input arc is representative of a change in an assignment score resulting from the assignment decision, wherein the plurality of nodes are grouped in a plurality of stages.

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25. The system of Claim 22, wherein calculating, by the computer, a corresponding optimal value for a directed graph representative of possible assignments of first and second observations comprises calculating the

15 optimal value by a network shortest path algorithm.

26. The system of Claim 22, wherein calculating, by the computer, a corresponding optimal value for a directed graph representative of possible assignments of

20 first and second observations comprises calculating the optimal value by a Dijkstra algorithm.

27. The system of Claim 22, wherein the cost function is

$$J_{s=} -\overline{x}R^{-1}\overline{x}^T - \sum_{i=1}^{s} \left\{ \begin{array}{ll} \delta x_i S_i^{-1} \delta x_i^T + \ln[|S_i|] - \ln(d_{min}) & a(i) \neq 0 \\ \overline{g} & a(i) = 0 \end{array} \right\} + \left\{ \begin{array}{ll} \ln([2\pi]^M |R|) & n_a = 0 \\ 0 & n_a > 0 \end{array} \right\}$$

wherein J_s = Assignment score

$\overline{x}$ = Estimate of relative bias

R = Relative registration covariance matrix

δx_i = State vector difference = $A_i - B_{a(i)} - \overline{x}$

S_i = Residual error covariance for pair A_i and $B_{a(i)}$

d_{min} = Minimum determinant of a residual error matrix

g = Gate value

M = Number of first observations

n_a = Number of non-zero entries in a

a = Assignment vector: $a_{(i)} > 0 \rightarrow A_i$ is assigned to $B_{a(i)}$

A_i = The plurality of first observations

$B_{a(i)}$ = The plurality of second observations assigned to A_i

28. The system of Claim 27, wherein the relative bias, $\overline{x}$, of the cost function is a simple bias.

29. A system for assigning observations comprising:

a computer operable to receive a plurality of first observations indicative of respective physical parameters observed by a first sensor system and receiving a

5   plurality of second observations indicative of respective physical parameters observed by a second sensor system; and

wherein the computer is further operable to assign a set of pairs of the first and second observations

10   predicted to correspond to the same physical parameter, the assignment comprising:

receiving a cost function that specifies a cost for each assigned pair, the cost not independent of the assignment of any other assigned pairs in the

15   set of assigned pairs; and

determining the set of assigned pairs corresponding to an optimal value for the cost function by calculating, by the computer, a corresponding optimal value for a directed graph

20   representative of possible assignments of first and second observations.

30. The system of Claim 29, wherein the computer comprising an application specific integrated circuit.

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31. The system of Claim 29, wherein the computer comprises a processor operable to execute a computer program stored on the computer readable medium.

30   32. The system of Claim 29, wherein the computer further comprises the computer readable medium.

33.   The system of Claim 29, wherein the computer comprises a digital signal processor.

5   34.   The system of Claim 29, wherein the computer comprises a field programmable gate array.

35.   The system of Claim 29, wherein the computer comprises a means for computing.

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36.   The system of Claim 29, wherein the directed graph comprises a plurality of nodes each representing an assignment hypothesis, the plurality of nodes comprising a root node, wherein each node except for the root node

15   has an associated input arc representing an assignment decision and wherein the length of each input arc is representative of a change in an assignment score resulting from the assignment decision, wherein the plurality of nodes are grouped in a plurality of stages.

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37.   The system of Claim 29, wherein calculating, by the computer, a corresponding optimal value for a directed graph representative of possible assignments of first and second observations comprises calculating the

25   optimal value by a network shortest path algorithm.

38.   The system of Claim 29, wherein calculating, by the computer, a corresponding optimal value for a directed graph representative of possible assignments of

30   first and second observations comprises calculating the optimal value by a Dijkstra algorithm.

39. The system of Claim 26, wherein the cost function is

$$J_{s=} - \bar{x}R^{-1}\bar{x}^T - \sum_{i=1}^{s}\left\{\begin{matrix}\delta x_i S_i^{-1}\delta x_i^T + \ln[|S_i|] - \ln(d_{min}) & a(i) \neq 0 \\ \bar{g} & a(i) = 0\end{matrix}\right\} + \left\{\begin{matrix}\ln([2\pi]^M |R|) & n_a = 0 \\ 0 & n_a > 0\end{matrix}\right\}$$

wherein J_s =   Assignment score
5          $\bar{x}$ =   Estimate of relative bias
           R =   Relative registration covariance matrix
           δx_i =   State vector difference = $A_i - B_{a(i)} - \bar{x}$
           S_i =   Residual error covariance for pair A_i
10   and $B_{a(i)}$
           d_{min} =   Minimum determinant of a residual error matrix
           g =   Gate value
           M =   Number of first observations
15   n_a =   Number of non-zero entries in a
           a =   Assignment vector: $a_{(i)} > 0 \rightarrow A_i$ is assigned to $B_{a(i)}$
           A_i =   The plurality of first observations
           $B_{a(i)}$ =   The plurality of second observations
20   assigned to A_i

40. The system of Claim 39, wherein the relative bias, $\bar{x}$, of the cost function is a simple bias.